



NSROC
Engineering

Dave Krause

NSROC Chief Engineer



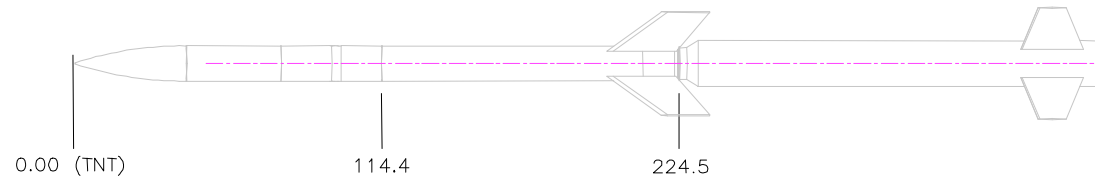
Ongoing NSROC Technical Efforts

- Terrier/Lynx Demonstration Flight Krause
 - Rate Control System
 - TV Video Compression
- Launch Date Commitments
- NSROC Staffing Plan
- New Motor Buy Status Maddox
- PTP/CD-ROM Progress Lankford
- Command Uplink Progress
 - Recent Interference at WSMR
 - NSROC Plan
- NSROC TM Test Set
- ACS Transition Shendock
 - Vendor Status
 - Sensor Development
 - ACS Systems
 - Schedule



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Terrier/Lynx Demonstration Flight



Payload

- Structures
 - AMI Nosecone (S.S. OGIVE)
 - Skins (RCS, TM)
- Diagnostics Package
 - 6 vibrometers
 - 2 3-axis Accelerometers
 - Solar aspect sensor
 - Magnetometer
 - TV Camera
 - Thermistors
 - Chamber Pressure Transducer
- Cornell Univ. GPS Receiver (COUGR)
- TV Video Compression
- GPS Antenna (14 inch _)
- Rate Control System

Lynx Motor

- Rocket Motor
 - solid propellant
- Lynx Tail Can
- Orion Fin set
- Raceway cover (4 ea)

Terrier Motor

- Terrier Mk 70 Motor
 - solid propellant
- Taurus Fins
- Drag Brakes
- Spin Motors (2 ea)
- CDI Deck

Notes:

Black = Existing Design

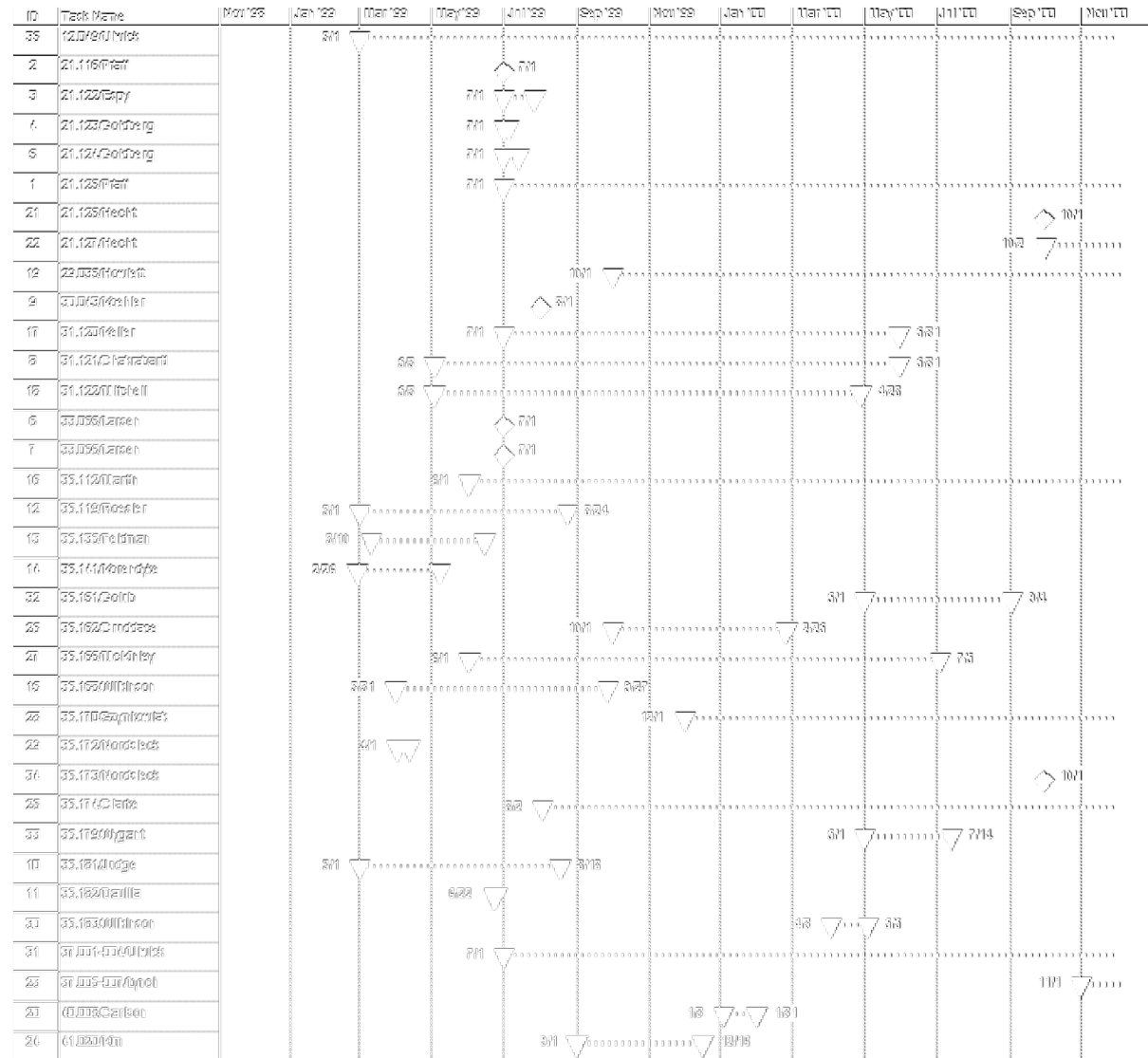
Red = New Design

Blue = NSROC Developmental Subsystem



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Launch Date Commitments





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NSROC Staffing Plan

- **Program Technical Staffing Shortcomings**
 - **Mission Managers**
 - Other technical staff “in training” as Mission Managers for some missions, such as Sub-SEM, SPARCS, Terrier/Lynx, etc.
 - Additional full-time Mission Managers being considered to support future workload
 - **Performance Engineers**
 - One new full time Performance Engineer started on 12/3/00
 - Actively looking for one additional experienced Aerodynamicist
 - **GNC Engineers**
 - One EE transferred to ACS
 - 2 full-time ACS engineers (minimum) required for successful ACS Transition on NSROC
 - **EE**
 - 2 new staff EEs on board



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Rob Maddox

Mechanical Engineering



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New Motor Procurement Status

- Schedule

- RFI March 1999
- Face to Face Discussions May 1999
- Publish Draft RFP July 1999
- Issue Final RFP August 1999
- Proposals Submitted October 1999
- Competitive Range Selection March 2000
- Demonstration Flight July 2000
- FY 01 Budget Issues Anticipated August 2000
- Delayed Procurement ~ 2 years November 2000



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Black Brant Motor Inventories

- Black Brant motors in current inventory 33
- Remainder FY 01 usage (planned) 10
- FY 01 BB motor delivery (remainder of interim buy) 18
- Inventory at Beginning of FY 02 41
- FY 02 usage ~11
- Inventory at beginning of FY 03 ~30
- NSROC "20 Mission Model" required 15 BB motors/year
- FY 00 Black Brant usage 10
- FY 99 Black Brant usage 19
- FY 98 Black Brant usage 16



Charles Lankford

Electrical Engineering

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ELECTRICAL ENGINEERING OVERVIEW

- **Command Uplink Status**
- **PTP CD-ROM System Status**
- **EE Group Program Enhancements**
 - TV video digitization/compression
 - High resolution analog data multiplexer
 - WFF93 PCM Data Test Unit
 - Automated PCM Stack Test System
 - Com Port Re-programmable Multi-Function Timer



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Command Uplink Status

Problem

- Command uplink lock status and receiver AGC show increasing loss of lock and increasing RF signal levels beginning at +140 to +380 seconds on 36.151 Golub mission.



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Command Uplink Status

Recommended Fix

- Find another uplink frequency outside of the TV broadcast band
- Use uplink command frequency which is more controlled or restricted
- Minimum modifications to flight and GSE hardware
- Minimum implementation cost to Program
- Quick implementation



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Command Uplink Status

Proposed Solution

- Worked with NASA WFF and WSMR Frequency Authorization personnel and choose 437.5 MHz
- Coordinated loan of NASA WFF 1 KW RF transmitters to replace bandwidth limited 200 Watt transmitters
- Coordinated loan of 1 NASA LHC and had SRP procured RHC Helix antenna transferred to NSROC to support new frequency
- Procured new PSL Quadraloop payload antennas at 437.5 MHz
- Coordinated Aydin Vector's re-tuning of existing RCC-103 command receivers to 437.5 MHz
- GSE hardware at WSMR being installed
- New flight hardware to be at WFF by early January



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PTP CD-ROM SYSTEM STATUS

- NNSROC EE's observed problems in the data time stamp, where reverse time jumps in seconds and Day of Year field were occurring. Problem seemed to show up when PCM drop outs occurred.
- Avtec has observed and reproduced the reverse time jumps in seconds.
- Avtec so far **cannot** reproduce the problem with jumps in Day of Year.
- Reverse time jump problem solved by Avtec.
- Avtec delivered updated device driver "fstsys" on 11/7/00. New driver installed on 1 PTP unit & checked out using Metrum tape from 27.143. Seem to have day jumps coincidental with uncorrectable errors.
- NSROC EE group still has some outstanding problems which have been presented to Avtec to resolve. The problems involve time tagging of data during high dropout periods of flight



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PTP CD-ROM SYSTEM STATUS

- Mission 27.143 (Wygant). Identified serious tape recording problems with flight tapes. Numerous “Uncorrectable” errors noted when playing back “Metrum” digital tapes. “Auto-tracking” feature on “Metrum” does not remove all of the “Uncorrectable Errors”. Discovered CSOC Metrum recorders had never been serviced by factory.
- Mission 27.143 (Wygant). Identified ground station setup errors at N-162. Personnel were using 90° clock instead of 0° for the clock input of the Metrum recorders and Apogee Labs Multiplexer. (Both vendors specify 0° clock phase as a requirement). This likely affected the data quality on the high bit rate TM link.
- These tape recorder problems & setup errors resulted in numerous dropouts which caused additional Time Stamp errors on the CD's



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PTP CD-ROM SYSTEM STATUS

- Additional problems have been discovered with the time code within the PTP system.
- A recent mission in WSMR proved that the PTP would not recognize time code from an good quality analog tape recording. It appears that the internal time code card (ISA-STG2) is sensitive to any noise on the time code signal.
- Continuous experimenter feedback of data quality or problems is still requested.



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PROGRAM ENHANCEMENTS

TV video digitization/compression

Status

- The prototype deck has been completed and electrically and environmentally qualified
- The first flight unit and support GSE was shipped to WFF in early September, 2000 and integrated into 12.050 Terrier-Lynx TM system.
- The flight modules were subjected to the full complement of payload testing for 12.050 with no problems noted during any tests.
- Mission 12.050 is projected to fly December 11, 2000 and will flight qualify this new hardware.
- Mission 36.197 Wilkinson has a requirement to fly one of these units in Summer of 2002.



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PROGRAM ENHANCEMENTS

High resolution analog data multiplexer

Features

- 12 bits resolution
- Dedicated differential amplifier and A/D converter per input channel
- Differential amplifier input resolves the difference between the two input lines(per input) and subtracts out the effect of ground loops and common mode noise.



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PROGRAM ENHANCEMENTS

High resolution analog data multiplexer

Status

- Flew successfully on 27.143 Wygant/Univ. of Minnesota.
- PSL has modified software to allow downlinking all 12 bits resolution for PCM formats with less than 12 bits per word.
- This new 2 word readout technique has been tested at WFF and will be utilized for upcoming missions 40.014 & 40.016.

Important Note!

- Recent automated PCM testing results have revealed the fact that payload wiring to these new high accuracy modules requires twisted pairs for each signal line.

PROGRAM ENHANCEMENTS

WFF93 PCM DATA TEST UNIT

Status

- Computer hardware procurement complete
- PC boards design under development
- Projected delivery of first unit: February 2001



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PROGRAM ENHANCEMENTS

Automated PCM Stack Test System

System Status

- A prototype system has been built and tested for 8, 10, 12, and 16 bit systems

Open Items

- Fabricate the Data interface PC Board
- Integrate the PCM decomm Board into host computer
- Complete the wiring installation of the Automated PCM Test System



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PROGRAM ENHANCEMENTS

- **Com Port Reprogrammable Multi-Function Timer**
Key Feature
 - Timer does not have to be removed from payload to be reprogrammed**Status**
 - Environmental qualification completed in March, 2000
 - Successfully flown on 36.183 Wilkinson and 21.126 Hecht instrumentation systems
 - Need one or two more qualification flights to be fully operational.



Bob Shendock

ACS Transition

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ACS Transition Plan

Overview

- Objective: Build a cost effective structure to meet current and future requirements
- Three year plan to enhance Attitude Determination and Control (ACS) capabilities and reduce cost
- Areas of transition include both the space and ground segments

Capability Requirements

SystemAccuracyRequirementsControlRequirementsTest SystemAvailableFlight SystemAvailablePassive Attitude< 2 degN/A10/0006/01Rate

Cost Estimates

System	Development Costs (k)	GSE Costs (k)	System Cost (k)	Refurb Cost (k)	Engineering Support Cost (k)
Passive Attitude	30	4	<< 2	< .5	<1
Rate Control	80	5	< 120	<45	<45
B Dot (Magnetic)	90	5	< 130	< 40	<45
Inertial	65	70	< 200	< 90	<<95
Celestial Acquisition	80	40	< 270	<110	<<95
Maneuver	60	10	< 200 / 270	<110	<<95
Fine Sun Acquisition	60	40	< 115	<20	<55
(W/Celestial Assist)	40		< 205	<40	<60
GLN200	50*	90*	70	<<30	N/A
ST5000	45*	75*	70	<<20	N/A
Fine Sun - TBD	45	10	15	TBD	N/A
	550	174			

Areas of Transition

- Space Segment
 - Sensors
 - Actuators
 - Flight Program
 - Processors
 - Systems
- Ground Segment
 - Data Processing & Analysis
 - Ground Support Equipment
 - Personnel & Processes
 - GNC Operations
 - Facilities

Sensors Under Evaluation

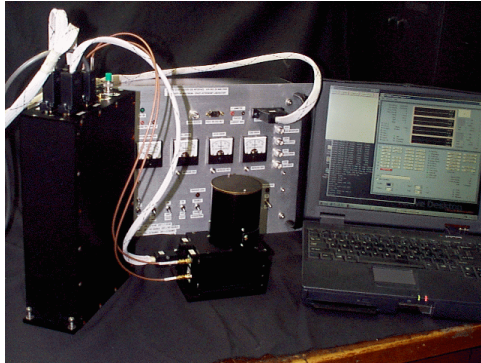
SNL GLN200



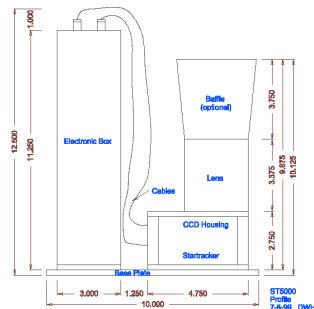
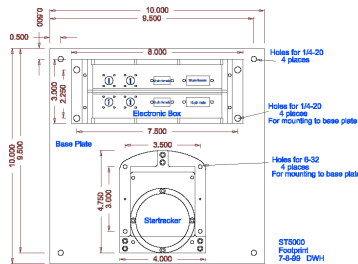
- Roll Isolate Inertial Measurement Unit
- Fiber Optic Gyro (FOG) Technology
- Function: support NSROC Inertial ACS
- Performance
 - Bias: 1 deg/hr
 - Random Walk: 0.05 deg/nt-hr
 - Scale Factor Stability: 100PPM
 - Operating Range: +/- 2000 deg/sec
- Status
 - Evaluation Unit (Big Red S/N 10) fabricated at SNL for NSROC
 - Currently at WFF for evaluation
 - NASA coordinating agreement
 - GSE Trade Study nearing completion
 - Scheduling test flight for FY01

Sensors Under Evaluation

ST5000



- STAR Sensor Utilizing CCD Technology
- Function: Support NSROC Inertial ACS with Celestial Acquisition
- Performance
 - FOV: 9.2 x 6.7
 - Limiting Magnitude: 8.7
 - NEA: 0.5 arcsec
 - Stars Tracking: 1-8
- Status - Signed agreement in place
 - Preparing SOW for FY01 acquisition
 - Scheduling flight for FY01



Systems Under Development

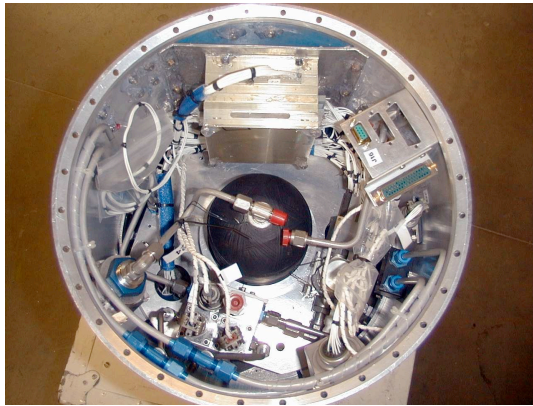
NSROC (a) Micro Sensor Array

- Micro sensor technology incorporating optical, magnetic and acceleration sensors.
- Function: Provide low COST attitude determination system approaching 1 degree of accuracy ($\sim \$1k / < 3\text{lbs} / \sim 40\text{ mA @ } 28\text{ Vdc}$)
- Status
 - Very healthy low-cost agreement in place with Army Research Lab
 - NSROC (a) System constructed for 12.050/Winstead in less than 3 weeks
 - Systems planned for 30.046/Laufer, 31.124 & 31.125/Croskey
 - NSROC designed PSCU $\sim 1.4''$ in diameter



Systems Under Development

NSROC RCS



- NSROC Rate Control System (RCS)
- Function: meet or exceed current RCS requirements
- Flight Program: NSROC Rate Control Mode
- S/N 1 assembled and tested for 12.050/Winstead
 - in less than 6 weeks
 - utilizing existing parts
- Status:
 - Fabrication and test complete
 - Awaiting launch of 12.050/Winstead.
 - Scheduling additional flights for FY01

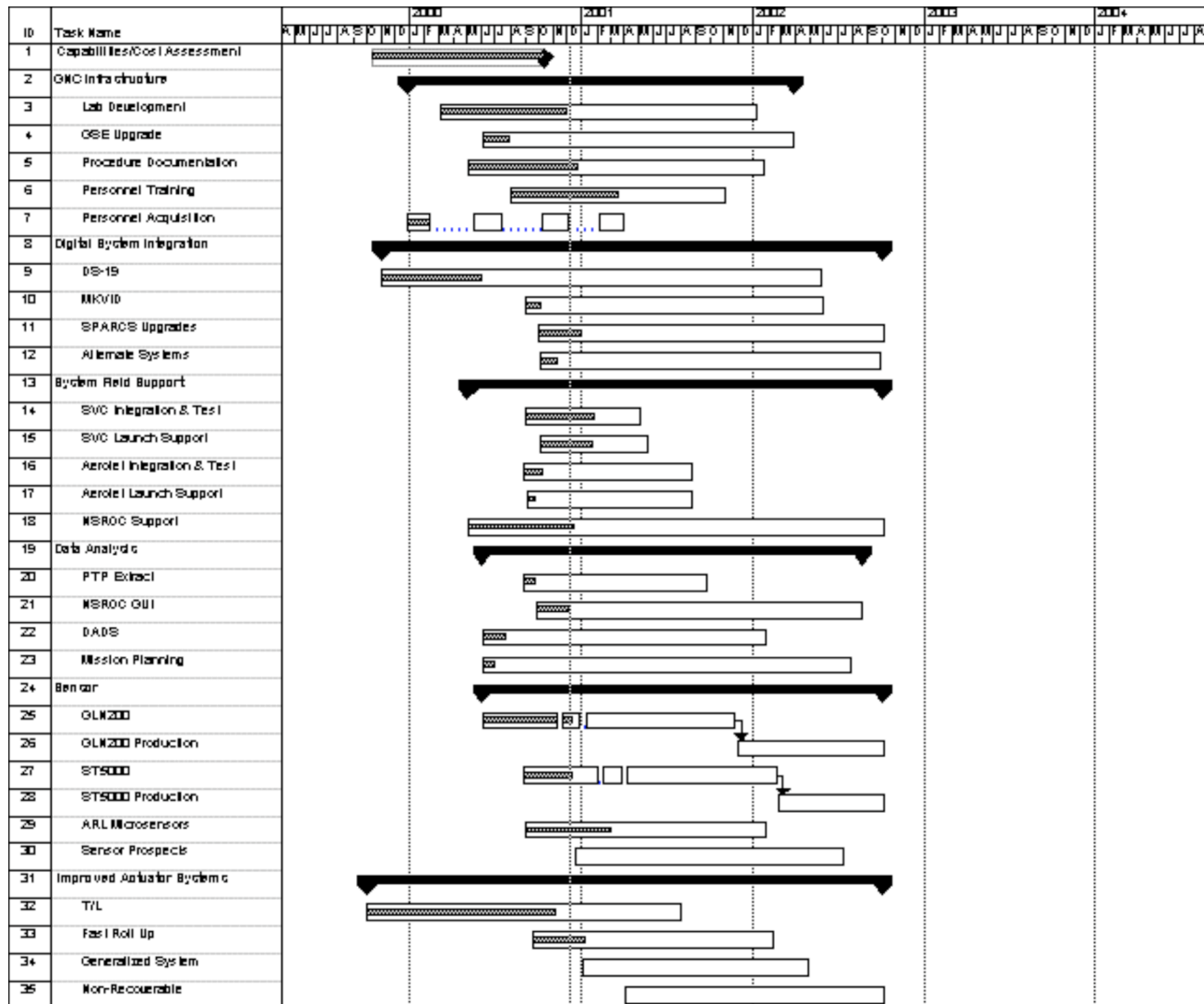
FY01 Critical Milestones

- Attained / Expected
 - NSROC (a) flight system
 - NSROC RCS Test Flight #1
 - NSROC Inertial Test Flight #1
 - GLN200 H/W acquisition
 - ST5000 Rights acquisition
 - enhanced pneumatics systems
- Requires support
 - GNC staffing
 - NSROC ACS test flights
 - GSE acquisition
 - GLN200 Rights acquisition
 - ST5000 H/W acquisition
 - Fine Sun Sensor H/W acquisition



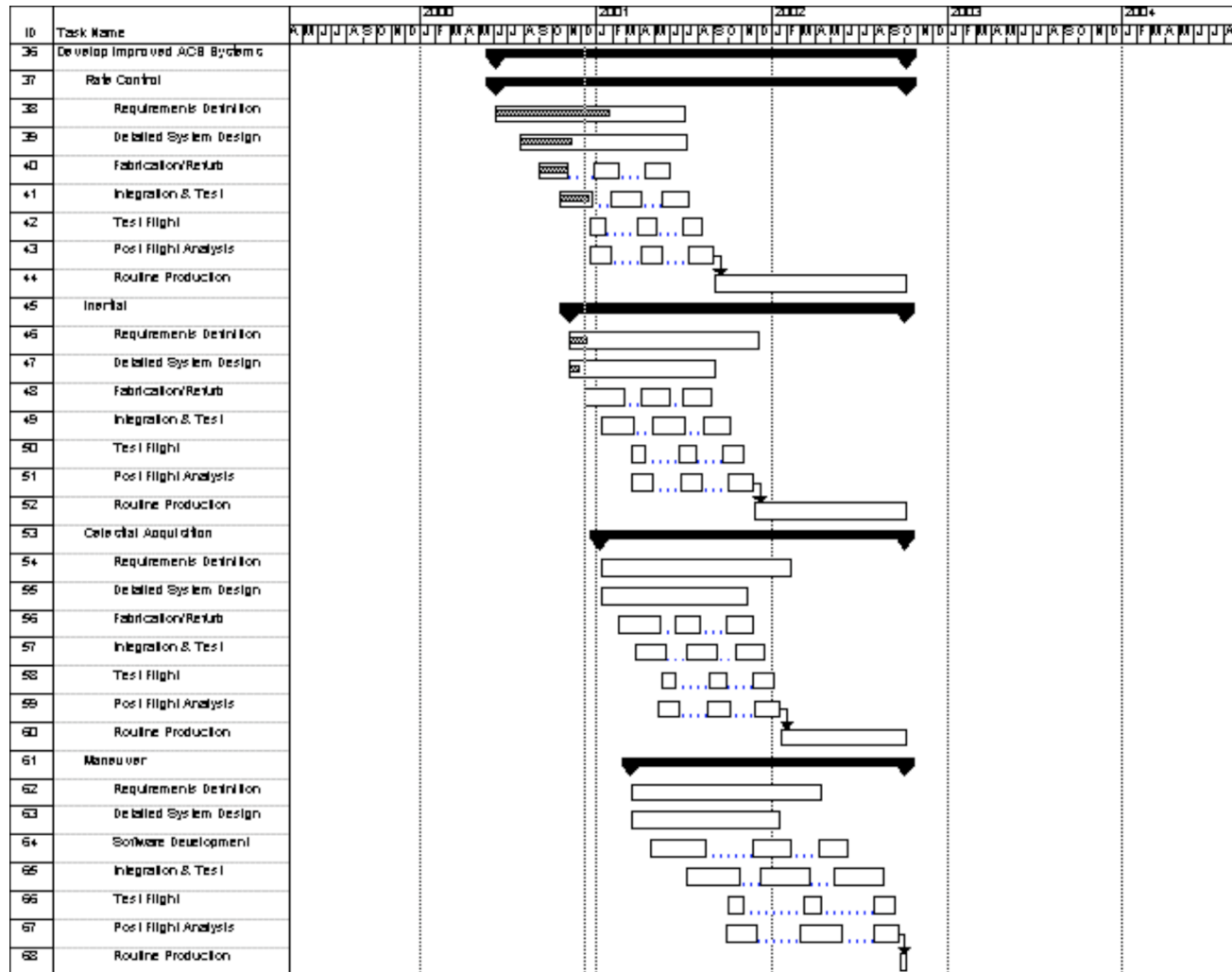
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ACS Schedule (1)





ACS Schedule (2)





ACS Schedule (3)

